PROMOTING SECONDARY STUDENTS' SHIFTS TO COVARIATIONAL REASONING: THEORY NETWORKING AND DIGITAL TASK DESIGN

Heather Lynn Johnson, Evan McClintock, and Amber Gardner

University of Colorado Denver

We investigate the question: How do secondary students shift to covariational reasoning when interacting with digital task sequences involving linked animations and graphs? Networking Thompson's theory of quantitative reasoning (Thompson & Carlson, 2017) and Marton's variation theory (Marton, 2015), we designed digital task sequences and analyzed students' reasoning. We report results of a small scale, qualitative study (n=13) investigating shifts in students' covariational reasoning.

Drawing on Thompson's theory of quantitative reasoning, we posited three critical aspects of students' covariational reasoning: their conceptions of attributes as being possible to measure; their conceptions of change in attributes; and their conceptions of a relationship between attributes. Drawing on Marton's variation theory, in the digital task sequences, we designed dynamic graphs in which students could vary individual attributes, then both attributes, within and across different backgrounds.

We conducted a series of three individual clinical interviews with each student. The first served as a preassessment. The second and third incorporated the digital task sequences. Our analysis built from description to inference to explanation. We inferred students were engaging in covariational reasoning when they worked to represent and/or describe relationships between simultaneously varying attributes.

Four students engaged in covariational reasoning in the preassessment. By the third interview, eight students engaged in covariational reasoning. Students' conceptions of how graphs represent the direction and nature of the motion of objects in linked animations (e.g., up/down, curving/straight) impacted their covariational reasoning.

Students can think that dynamic graphs should resemble physical features of the motion of objects in linked animations (e.g., if objects in linked animations move up/down, so should dynamic graphs). To promote students' covariational reasoning, provide students with opportunities to sketch and interpret different dynamic graphs with physical features distinct from the motion of objects in linked animations.

References

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